Toward a Sustainable Green "Planet Earth": On the Impact of Global Warming on Biodiversity and the Ecosystem

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ABSTRACT

This paper discusses the burning issues related to *global warming* and the ensuing loss of biodiversity resulting from such anthropogenic-induced cause of global warming. The research further on proposes that actions should be based on balanced judgments and strategic initiatives which are on the call of the hour. The strategic frontiers are those related toward embracing a greener concept, by adoption of green, renewable technology to minimize the phenomenal global warming, and which as much depends on human actions—since, the concept of global warming is the result of anthropogenic actions. In such parlance, it seems evident that it is again by human actions which might help mitigate this burning problem and pave way for a greener, sustainable future.

Keywords: Global Warming, Sustainable growth, Green Technology, Policy actions, IPCC

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Introduction

We inhabit a stunningly beautiful planet, a blue-green earth when seen from the space outside, but in reality from the inside, this is turning out to be resource constraint earth, less in green but more exhausted in the face of a resource hungry mankind. This exhaustion is owing to the unending exploitation of natural resources from the time since human beings became cognizant about their own needs and necessities, and became aware of their own desires and wants. Nature has indeed abundant of natural resources, but most of those which are finite; i.e., forest, fossil fuel and ore. Exploiting the bounty of nature hence, in essence, is intrinsic to human nature who seek for and command the resources that the nature presents. However, expanding on the far side of the capability to sustain unremitting human wants and desires have led to the rise and fall of many cultures and civilizations [Wackernagel & Rees, 1996]. To sustain growth of civilizations, exploration and exploitation of natural reserves have led to gradual loss of biodiversity, depletion of precious mineral resources, and obliteration of enough forest floors. Our planet is getting less green by the day, because of overwhelming loss in verdure which is due to inexorable deforestation [Mitchell, 1997] to make space for massive urban sprawls, mass obliteration of trees for timber (resources) and their concerted impact on biome floras. The ecological impact of deforestation and the beneficial role of forest have been established [Molchanov, 1970, Sokolov, 1982, Richards & Tucker, 1988], though the policy response towards wildlife and habitat destruction, coupled with biodiversity loss, has been rather, confusingly timid. To support growing economic activities, population boom and urbanization, the need for space and resources may be justified. But the "uncertainties" regarding long term future effects of deforestation— on the other hand, remains large enough— which have engendered misperceptions concerning assumptions of such uncertainties as signs of "endangerment" which perhaps delays policy response [Schneider, 1989].

Going back through geological timelines, some 40 million years ago, our earth was perhaps a lot of much warmer place than what it is these days. The earth's unsteady

atmosphere stabilized and therefore the temperature bit by bit moderated till around 2.3 million years back when the planet cooled down and became habitable. From then on, the earth's average temperature remained stable until but following the industrial era, when earth's surface temperature started to increase again due to global warming. This warming— called the *Global Warming*, [the term originally coined by Wallace Broecker, 1975] is an "artificial" warming of the planet on account of greenhouse gas emissions ensuing from human activities and hence—is anthropogenic. Greenhouse Gases (GHG) like carbon dioxide (CO_2), methane (CH_4) are notorious for trapping and re-emitting infrared radiation which increase the surface temperature of the earth. Such rise in surface temperature would have adverse impact on biome and the marine ecosystem, and is likely to induce a rise in sea level owing to the warming up of sea water. There have been substantial rise in greenhouse gas concentrations in the atmosphere within the past century, significantly that of carbon dioxide —from a pre-industrial concentration of 270-280 ppm to 355 ppm (Vitousek, 1994). The causes have been attributed to human factors, and hence, the remedial measures also demands human interventions.

This paper, hence, discusses these aspects in some details and examines how this issue can be mitigated, possibly seen as resolutions to this problem of global warming by suggesting the Green Path toward sustainable development and economic growth. This paper calls for a shift from non-renewable toward renewable energy resources which might mitigate the harmful effects of global warming; and which moreover, may lessen the burden of carbon footprint and carbon dioxide (CO_2) load on the atmosphere.

CO_2 Emission Projections: Shift in Economic Evolution

There have been innumerable projections till date of and about the emission level data and possible global temperature rise alongside rise in sea levels. This paper does not attempt to review all those, but in purview of the issue of global warming, highlights some of the recent proceedings and discussions on the same. Recent data

points out that the emissions recorded during the period 2000-06 has been ~234 Gt CO_2 [Meinshausen, *et. al.,* 2009]. The authors (Meinshausen *et.al.*) project their GHG emission budget for the period 2000-50 that might help limiting the atmospheric arise in CO_2 and hence, limit rise in surface temperature beyond 2°C. The cause of such emissions, however, has been attributed to the same grand old origin— fossil fuel burning inducing change in global biospheric carbon reservoir [Freyer, 1979] which as the primary source of this increase, is the subject of main concern to environmentalists. The reasons behind such ecological shift relates to the major evolutions in economic growth which characterizes the recent patterns of socioeconomic progress.

The patterns of socioeconomic progress embracing globalisation as a tool for sustainable growth and development has resulted in a very major shift, which, according to George A. Seielstad— ecological shift both in terms of human ecology and workflow; a mass migration from the more rural to the urban areas that seems to support such prospects of economic growth, employment, knowledge creation, innovation and prosperity [Seielstad, 2010]. This has resulted in greater demand for land and energy resources to fulfil the needs of urbanites and consumption patterns in urban metropolises. Beyond doubt, globalization's reach to the foremost remote corner of the world has been supported by evolution and revolution in technology and industrial processes, and even rather more by revolution in info technology (IT). However, these have so, placed vast constraints on the physical and natural resources that are scarce. The heightened energy demand coupled with rising consumption patterns buoyant on new economic process have redefined the economic science of subsistence [Nordhaus & Yohe, 1983], by raising the living standards of billions of individuals across the world, measured in terms of Human developmental Index (HDI). Nonetheless, this has resulted in deficiency of land area and natural resources and that came at a price to our surroundings. The matter long-faced by economists and policy makers thence is, how to accommodate this surging demand with restricted resources that all the same demand "smart allocation" of such resources

within the face of billowy consumerism. Let this problem be better self-addressed by market forces. The deficiency nevertheless, has resulted in vigorous search for energy and natural resources from unconventional sources that are renewable, so as to sustain the current trend of economic growth. The matter long-faced by ecologists on the opposite hand, are but, manifold; (a) how to conserve our ecosystem, (b) to model the longer term impact of diversity loss, (c) to measure the impact of greenhouse gases on the atmospheric system, and (d) to develop sound policy framework primarily based upon which choices might be delegated to the policy makers. However, beyond reduction of natural habitat, what that has affected the environment most—is the unrestrained emission of industrial pollutants—some of those are greenhouse gases (CO_2, CH_4, chloroflourocarbons or CFC's) that are both polluting the environment, furthermore raising our planet's atmospherical temperature. Others include sulphur containing pollutants and aerosols which are coolants, whereas, water vapour, and alongside other trifling GHG's also has conjointly been involved as a minor cause of temperature rise. Nevertheless, how can this problem be addressed? Once more, by market forces? This does not sound extraneously surprizing. It is not that humanity does not have any perception of the dwindling energy resources. And it is neither that we tend to lack perception of (un)certainty, however it is one thing that is lacking most—is, perhaps, the awareness of the ways to conserve our remaining ecosystem and evermore, to understand the forthcoming effects of ecological and global change [Vitousek, 1993(1994); Jones, Lawton & Shachak, 1997; Cline, 1992; and Schelling, 1992]. It is where economic science meets ecology, and maybe, each would possibly demand some answers from one another.

Human Activities and their Effects on Biodiversity: Strategic Options

Conservation and degradation of the environment is both reliant on the nature of human activities in the backdrop of technological progress. Some technology pollute while others are being adopted to counter such pollution. Towards

responsibility of the environment, some aspects of human activities are meant to be streamlined in the direction of responsibility for others, and for the future generations to come. Since biodiversity is an all-encompassing, integrating all biological and species specific genetic variability, conserving it is a daunting task, as stated by Walker [1992]. According to Brian Walker,

"Biodiversity is taken to be the integration of all biological variability across all scales, from the genetic, through species and ecosystems, to landscapes"— [Walker, 1992].

Our planet is biologically diverse, and the biological diversity is immensely multifarious, integrating all biological changes, while Ecology studies the relationships between living organisms, each other and their environment. Anything conceived to preserve our environment, and hence biodiversity, must depend on how far such diversity can be maintained, how species loss can be minimized and what conservation methods should be adopted. This also includes the nature of humans actions and on the landscape of technological breakthroughs, and then on the aspects of how to adopt and adapt such technology into a more admirable "Green Concept". Outlined below—

1. These can be categorically divided into two general aspects;

a) Counter global warming by checking pollution levels,

b) Search for alternative renewable energy resources to preserve the biodiversity

Several efforts are in line for energy production without causing loss of biodiversity; i.e., the harnessing the power of solar energy, offshore wind mills, and seeking for other alternative sources to fossil fuels like coal and crude oil.

2. However, any such alternative energy resources should also mandate two functions;

a) Such alternative energy resources would be less pollutant,

b) Exploration for such energy resources should not constrain or harm the environment any further.

The above arguments— from (1) and (2) forms the foundational aspect of this paper based on which this present discussion would loop around. It shall be recalled that the primary cause of greenhouse gas emission is on account of CO_2 emission levels; fossil fuel combustion and industrial pollutants which has increased carbon-dioxide concentration level from ~280 to 355 μL/L since 1880 [Vitousek, 1994]. It is beyond doubt that this rise in carbon dioxide concentration is anthropogenic. Fossil fuels contains a very high percentage of carbon, i.e., coal contains 92% and oil has 86% of carbon composition. Combustion and burning of these release enough carbon in the atmosphere, and due to its unique bonding capacity, the released carbon bonds with atmospheric Oxygen, forming CO_2. Most of the carbon is stored in plants, fossil fuels, natural gas and petroleum. Burning of all these generally releases substantial amount of carbon in the atmosphere. However, the carbon cycle is uniquely maintained; that is, besides plants which absorb CO_2, ocean-bed also acts as a sink which too absorbs CO_2 from the atmosphere. For a detailed account of carbon cycle, the reader may wish to consult the literature on carbon cycle [Ramanathan, & Carmichael, 2008]. Nevertheless, several evidences points to this point of view that the major share of carbon emission in the atmosphere is on account of human activity. All industrial activities are the result of human actions. Since energy resources are dependent on mineral sources, biodiversity is affected when consumption pattern is misbalanced; that is, when consumption occurs at a rate faster than the rate of production. This also, nevertheless, depends on the nature of human consumption. To match demand, productivity tends to increase and such increased rate of production demand raw materials as inputs which however put pressure on the already constraint ecosystem. The fallout being, in search for productive resources in order to match energy demand, leads to a greater degree of exploration for energy and mineral resources. Higher rate of energy consumption from increased industrial and human activities also leads to the loss of biodiversity,

since, conservation of the environment also means how much *biotic resources* are conserved, which in turn, conserves the ecosystem. In the face of such increasing energy demand to sustain the global agility (globalization), the rate of exploration in search for minerals and non-renewable energy resources has increased manifold in the last two decades. Categorising biotic resources into renewable and non-renewable sources of energy is tabulated as follows:

Renewable Energy	**Non-renewable Energy**
Biomass, solar energy, wind, geothermal energy, and hydropower	Coal, oil, natural gas and uranium

Among these, three of the primary non-renewable energy are fossil fuels; coal, crude oil and natural gas. All mineral resources found in the earth's crust are non-renewable.

Human activities are essentially complex; yet, 'more' human activities does not suggest that there will be "more" emissions. There can be human activities without any effect on biodiversity, as there are activities which affect our ecosystem. But biodiversity is also reliant on mineral and energy deposits since, depletion of all would inevitably result in loss of flora and fauna and habitat destruction. It is by nature of human activities defining the characteristics of industrial activities which determine greenhouse gas emissions. However, it would be reprehensible to say that loss of biodiversity is "inevitable" in the face of burgeoning industrial activity and rising consumption patterns across countries and regions. Consider such a scenario, technologies which are less reliant on onshore mineral deposits but more on alternative energy resources; aka *"Green Technology",* are being adopted. Examples of such "Green Tech" initiatives are Solar Energy, Wind mills, offshore wind turbines, tidal waves, geothermal power, and others which incur less injury to the biotic diversity. Since green tech is less reliant on fossil fuels and where, nothing actually

"burns", the combustive emission should be less pronounced and which is more reliant on alternative resources that can help *cut down* the level of *greenhouse* gas emissions. Seen other way, such green initiatives would also help preserve biodiversity. So, this technology, the Green Technology— is a double aged sword to counter humanity's anthropogenic ecological problems and hence maintain ecological balance. However, the decision consequence of human actions would likely define what technology humanity should adopt, and how that should be adopted, over how resources could be optimally allocated to maintain biodiversity, and how to manage the ballooning consumption patterns— without causing further damage to the environment. In the next section, I discuss these issues relevant to the context of reducing the negative impact caused by rising green-house gases. In such parlance, the above mentioned arguments are taken into consideration which would further help elucidate the core issues in managing and formalizing effective strategies toward sustaining a greener earth—our home. The prime motto is— if things cannot be restored, it can however, be conserved.

The Philosophy and the Concept of Global Warming

The idea of "global warming" was seeded throughout the first a part of the last century when people began to note that winters weren't as cold as they were before, and summers were getting hotter more than what they were before [Wackernagel & Rees, 1996]. Meteorologists scrutinized the records and confirmed the event based upon observable scientific evidences that the common temperature increase on the west Palmer Peninsula (Antarctic) since 1950 in winter is 8.8°F[1]. Melting of polar ice caps were recorded as early as 1978 with annual breakup of ocean ice off the coast of America's Last Frontier—Alaska. The Arctic ice has since then decreased by about 9 percent per decade [2]. The collapse of the Larsen ice shelf in 2002 rang as a symptom of melting glaciers within the Antarctic region which could ultimately contribute to rising ocean levels [3]. These two regions—Arctic and the Antarctic, being poles apart, represent the biggest share of land coated by ice and glaciers.

With melting polar ice caps that may be a major contributing factor to sea level rise, in keeping with the Intergovernmental Panel on Climate Change (IPCC), the average global sea level rose between four and eight inches (4-8 inches) within the past hundred years. This has been attributed to the rising level of CO2— the concentration of that which helps determine earth's surface temperature. Sea levels may not only rise on account of melting polar ice caps, but also due to the thermal expansion of warm sea water [Meehl *et. al.,* 2005], [Merrifield, *et. al.,* 2012] since, volume of water expands on heating. As a consequence of rise in atmospherical CO2 levels over the past one hundred forty years thanks to industrial activities and fossil fuel burning, earth's surface temperature is rising [Broecker, 1975]. And such an increase in temperature is perhaps slowly seeding the seed of a globalized phenomenon believed to be behind the repeated episodes of shift in seasons and frequent incidence of hurricanes and flash floods [Trenberth, 2005].

Unprecedented increase in hurricanes within the North Atlantic and tropical cyclones or typhoons within the Pacific has been associated with global warming, as some scientists claim. Over that, early warning from Corals that dwell in warm tropical waters where rise in temperature is inflicting a "bleaching effect"—rendering a number of them permanently bleached—forming Coral necropolis[Montaigne, 2004]. Corals starts to bleach once water temperature rise to about 85°F. Inevitably, rising global temperature affects the marine ecosystem and therefore the Coral reefs in addition. Inescapably, temperature change in the midst of warming is taking a toll on flora and fauna, according to a study revealed in Nature [Pounds, et. al., 2006]. Alan J. Pounds *et. al.*, showed that large scale warming altering the surface temperatures are associated with disease outbreaks in amphibians which might lead to mass extinction of several species.

Eventually, the trouble the issue of global warming has become extremely contentious, and there are furious debates taking form over the rate at which earth's atmosphere is warming, though there's general agreement that it is so warming. As

of nevertheless there's no accepted model that might properly predict the rate at which the atmosphere is warming, though some estimates consider a 0.3 degree Celsius increase per decade in global temperatures over this century. As from Broecker (1975) who proposed that for each 10% increase in CO2 concentration in the atmosphere, there could be a mean 0.3°C rise in global temperature. Nevertheless, there is a long discussion and scepticism over the factualness and potency of computational models in predicting such an increase, which implies that— by 2050, atmospherical temperature might rise by about 1.5°C, and by the tip of this century, that would be anywhere between 2.5°-3°Celsius. The increase in global temperature over the last century is factual, but the real danger and potential problems it might produce still remains undetermined, due to the existence of uncertainty on this issue (Lindzen, 1990). Thousands perhaps even more articles galore the newsstands, in magazines, newspapers, pamphlets and in the common media regarding this issue of global warming enumerating that there are indeed some global concerns regarding the issue of global warming. Hence, one of the primary goal of IPCC and therefore the UNFCCC backed Kyoto Protocol is to limit such an increase in earth's temperature to about 2°C by 2050. To tackle this problem, numerous protocols have been adopted, the most prominent being the Kyoto Protocol, and several UN Climate Change Conferences have taken place with the sole goal of reducing the emission of Greenhouse Gases (GHG) from anthropogenic actions— typically those emitted from industrial activities.

Progress at the Cost of Environment

The economic cost of biodiversity loss and the ecological effects of such has been widely studied by both ecologists and economists [Perrings et. al., 1992]. The question is, can we sustain the present trend in economic growth without causing further damage to our environment? Certainly, the efforts are in line with industries adopting green policies, generating consumer awareness about sustainable eco-friendly green-life. Policy makers and industrial organizations are charting out benign methods of reducing emission of GHG's. We are becoming more aware

about eco-driven sustainable technology having low emission levels. Moreover, ruralisation of urban life through enhanced green cover backed up by planned suburbanization is slowly transforming congested urban metropolises into cosmopolitan villages. Societies are now more cognizant about biodegradable, eco-friendly recycling technologies salvaging raw materials and energy from decomposable materials. Numerous studies describe such prospects of energy sources from renewable resources [Holmes & Papay, 2011]. That there can be industrialism without pollution and biodiversity loss could become a veritable alternative. This path toward sustainable and eco-friendly growth although, is extended and multifaceted, but in the long run, today's actions would definitely yield into tomorrow's fruits of labour.

Indeed, our progress through the industrial era has been incredible but that which emanated at the cost of environmental degradation, loss of biodiversity and natural habitat destruction. And that, which is still befalling in the newly-industrialized countries who were until by the end of the last century, by far only a minor contributor to industrial pollutants, their share of emission have increased considerably within the last two decades, whilst, the majority are still being contributed by the developed nations. But the growing share of CO_2 emissions by the developing nations might well catch up with the developed nations by say, around 2030. As Nordhaus & Boyer [2000] points out using their dynamic models of global warming— DICE and RICE models, the cost and challenges to be overborn by the nations reflect similar estimates to the Kyoto Protocol, but in the longer run, Kyoto protocol might be inefficient. This is because, as I have mentioned above reflecting the views of the authors, the Kyoto Protocol is designed to target only the high-income countries, leaving out largely the low-income countries out of purview. But it is here, in the developing countries, where the growth is about. This problem of Global Warming is—hence, according to them, the most important problem nations are facing in transition through the new millennium, and by new economic models of growth. Adoption of green, eco-friendly technology in the

evolving, emerging markets could well prevent turning our green earth into a green-less biosphere. But there is "little awareness" growing about greenhouse emissions in the developing countries. And there is still yet, little awareness about sustainable technologies (Green Technologies) meant for low emission within the developing economies who are largely at the forefront of this economic growth. The point is, who should sacrifice more—the developed or the developing countries? Nonetheless, anthropogenic and industrial activities—broadly from the developed nations, has affected the bio-ecosystem in an exceedingly broader fashion— in such a way that there is only 20% of the entire space of the planet's surface left over as inhabitable forest reserve. The point then is, why should the axe be on developing nations which are hugely benefitting from globalization? But then there is again a counterintuitive argument; to preserve and conserve whatever that is still left as inhabitable biosphere (i.e., woodlands and forest floor). Since, this in no time, would be occupied to accommodate a billowing population, and to fulfil the economic demand for resources like timber and ores, unless we tend to care [Robinson, 1992] regarding what has already been lost. Indeed this (globalization) is a huge progress but which came with a greater cost to the environment and biodiversity. There again, arguments arise whether if it would be rationale to limit the progress of economic activities in the poor nations who are already riddled by poverty, or put in binding regulations as emission guidelines for them to follow. To sacrifice growth in lieu of cutting down on emissions level is certainly not an imposing idea, and furthermore, to sacrifice the environment and the ecosystem to sustain economic growth is even a bigger problem which might endanger human life on this planet. The reasons for the former are compelling; since, it is estimated that by 2050, earth's temperature may rise by a median of 2°C. As a consequence, the rise in sea level is projected to be around 320% by the end of the 21st Century [Meehl *et. al.,* 2005], or around 160% by 2050. This might create as a drag to many "island nations", isle, atolls and coastal areas around the world which are densely populated. For more about island biogeography, the reader may wish to consult MacArthur & Wilson [1967]. By 2040,

it is additionally projected by the World Energy Council [WEC, 2007] that most of the mineral deposits are going to be depleted thanks to higher energy demand and heightened industrial activity to support a roughly eight billion earth based inhabitants. The World Energy Council also projects that energy production will increase by about 80% by 2050. There will be a heightened demand for renewable energy resources to fuel the peak economy by 2050. It has been further projected that about 80% of people will live in cities by 2050. What is more, global energy demand is expected to expand by about 45% by 2050. Add to this, our world is already resource constrained. And since we are already resource constraint, our continuing effort is way devoted in search for energy resources from sources other than minerals and traditional fossil fuels; such alternative sources of energy resources are i.e., solar energy, wind energy and geothermal energy. Unconventional non-renewable sources of energy like nuclear energy from uranium deposits could also be insufficient to satisfy the long run energy demand. Our own activities have not only depleted a major share of energy and mineral deposits, but has led to improvidently affect the biodiversity, destroying enough natural habitat and putting various species at the face of extinction. With natural resources running out onshore, search for and exploration of the ocean bed as offshore supply of mineral and energy resources has led to deep sea-bed mining, dredging and drilling activities, both along the Continental margins, Continental shelves and Shallow inland seas [Strahler, 1976]. Indeed, the deep ocean floor is rich in natural resources which might well substitute for dwindling onshore ore deposits, but again, that is likely coming up at an enormous cost to the marine bio-ecosystems. Hence, there should be a balance in policy making and judgment so as to find better ways to sustain the current rate of economic growth without causing a greater harm to the ecosystem any further. The search for such a solution lies in sustainable technology and technology which would "pollute less *but* produce more".

Research on the topic of environmental degradation have shown that much damage has already been done with consequences leading to heightened natural

calamities due to "rising sea levels" on account of unrestrained greenhouse gas emissions which has enhanced the surface temperature by about 1.5°C. However, this rise in sea level on account of greenhouse effect is, to some scientists, is scientifically unfounded and hence, debatable, as [Robinson *et. al.,* 2007] posits. Indeed, it is factual that shift in climatic patterns are highly uncertain, and nothing could be predicted precisely about the future of the Earth. But there is "something" beyond the science of predictability and uncertainty; the prevailing impact of change in climate and weather patterns that humanity is presently 'being affected' with. That is, the rising trend in natural calamities those related to frequent hurricanes, storms and heat waves that foretells that "something is underway". Nonetheless, with ozone depletion the signals as signs and symptoms of an ecological disaster is within the line; with frequent occurrence of hurricanes and flash floods, reversal in weather patterns, leading to either drought or torrential rain, and melting of the polar ice caps with a continual rise in the sea level [Morell, 2004]. These are 'something' which are nevertheless, underway. Policy makers and environmentalists are definitely in search for a solution; a resolution to cut down greenhouse gas emissions, conserve biodiversity and maintain ecological balance, and more than that, instil in ourselves a sense of responsibility toward our planet earth—the only home we have until now. This is a colossal international problem and hence demands comprehensive attention—not simply to stimulate our sense of eco-consciousness, but to act forthwith and without delay. From the common people to the governments, from legislators to environmentalists and also the policy makers, everybody have dispensed concerns regarding the rising emission levels and have vowed to cut back carbon dioxide emissions and limiting global warming to 2°C. In role of that, the United Nations adopted a Charter under the auspicious of the UNFCCC.

According to the United Nations Framework Convention on Climate Change (UNFCCC), the definition of emission, GHG and other terms adopted for the purposes of this convention can be accessed from this title, (UNFCCC, 1992).

The definition for 'emission' and 'GHG' according to UNFCCC (1992) read as—

> *"'Emissions" means the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time."*
>
> *"'Greenhouse gases" means those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation."*
>
> -Source (UNFCCC Report, pg. 7)

As is evident from the declaration of the UNFCCC Charter, GHG's are emitted by "human activities"—*anthropogenic*, where such emissions release gases which trap heat and re-emit infrared radiation, which further cause heating up of the surface.

Since yet again, human actions would likely define what consensus and technology one should adopt to help conserve the environment, maintain the residual biodiversity and sustain the ecological balance. More than that, it is a struggle for our own collective survival from the perilous effects of ecological destruction. It is a high time to reduce the negative impact caused by human activities and our present cognition and understanding of the problem would help us to reshape, formulate and transform the current technology to adopt a "Greener concept", a concept of "Green Technology". This concept of "green tech" is perhaps a few of the remaining formidable solutions to preserve and conserve our environment and the ecosystem, and prevent any further damage to the environment done so far.

Warming Up: By Human or Natural Causes?

Before jumping onto any conclusions regarding what caused the global warming, it is imperative to reconsider whether if our earth has really warmed up or otherwise, as claimed by a consortium of scientists [Robinson *et. al.,* 2007] who posit that the concept of "human-induced" global warming is unfounded on scientific rationalism. They claim that there is no rationale for considering that our planet is warming up, and even if so, such is not on account of anthropogenic activities—but

in lieu of natural causes. Hence, what it seems apparent is that, and foremost, it is vital to understand how the temperature of the planet is maintained, and what role carbon dioxide have, in maintaining the temperature of the earth. And what further role—if any, does the greenhouse gases, including CO_2 might have, to cause further warming up of the planet. Following this, it is also important to account for the natural causes which might also contribute to global warming, and how far they could affect earth's ambient temperature should also be considered overbearing in the light of this debate. Scientists who have studied these phenomena have come to the conclusion that indeed, the earth is warming up, and that which is "beyond doubt". Indeed there are overwhelming evidences that industrial activities do cause pollution of the environment, by contaminating natural aquatic reservoirs and the ground water, and modifying the normal constituents of the atmosphere by making it more toxic for human to breathe in. And it is even simpler to assume contrary to popular belief that it is easier to warm-up the earth, but is it difficult to cool it off. On the other hand, the matter is not just about "warming" although which is warming up. The concern has also been about the levels of toxic pollutants emitted by industrial activities polluting the land, water and air, and having deleterious impact on biome plant and animal life—more so, presenting as health hazards to humanity. A simple experiment would likely establish the variability in the levels of anthropogenic activity induced pollution. Pollution index could be derived from sampling of air from and near industrial areas and comparing that to the air quality in pristine serenity would definitely yield different results and draw conclusions regarding the effect of industrial emissions on the air quality. It is important not to ignore what scientific evidence ought to tell us—more than what consensus could be built upon such evidence. It is because only such methodical and systemic proof as evidence should be adopted as agendas in policy making—and what should not be adopted are those based on popular or common beliefs. More than that, efforts should lie on the context of actions 'without hurting" the industrial progress and development, and which would likely sustain the pace of economic growth whose

benefits are wide-reaching, and more so, in the emerging economies. Other way of saying is that, there can be industrialism "without" pollution. And such industrialism grounds on the philosophy and concept of 'green technology' which does not 'burn'— neither cause pollution.

Policy making in ecology cannot be initiated solely on the basis of melting glaciers or polar ice caps, rather, on the possible impact of such on sea-level rise and its effect on life on the coastal regions. Uncertainties regarding the future impact is difficult to assume, whereas the present although can be correlated, but there remain and arise a lot of ambiguities related to simulations which predict events based on computational climatic models. The computational infrastructure used to generate rhythmicity and detect specialized climatic patterns are based on historical data, extrapolation models and simulations—means, those are predictive models. One way to validate such models is to use data from experimental field trials or controlled climatic models in the lab to examine such computational models, and then, using such computational analysis to validate experimental results. Policy making in ecology, hence, should incorporate confirmed data derived from the whole enchilada pertaining to the modelling of loss of biodiversity and greenhouse gas emissions which are anthropogenic. But it shall be kept in mind that "greenhouse effect" has also natural causes, of which I discuss in about in the following sections. Insofar, the exoteric fact is, there are contentious debate over the issue of the impact of CO_2 level on the environment, to the extent wherein some scientists claim that higher concentration of CO_2 level in the atmosphere is beneficial for greenery and plant growth, while most others champion for the cause for its reduction. But it is nevertheless a fact that a higher concentration of CO_2 also poses as health hazards to those already predisposed to respiratory ailments. Moreover, carbon dioxide traps heat in the atmosphere and causes depletion of the ozone layer. For such reasons, carbon dioxide is dubbed as a greenhouse gas. However, among the major greenhouse gases, whether CO_2 cause less or more warming of the earth when compared to water vapour (H_2O), is nonetheless, debatable. Primarily, there are three

greenhouse gases; CO_2, H_2O and CH_4. Compared to carbon dioxide and water vapour, Methane (CH_4) plays trivial role in global warming. Apart from these, there are some common misconceptions born out as folklores unfounded and devoid of any scientific truths. Countering such misconceptions, those can be simply put as:

Greenhouse gases—:

—do not cause or induce Tsunamis,

—are not the causes of Earthquakes,

—do not "*decrease"* the extent or diversity of plant life or vegetation, and

—do not cause human population boom.

On the contrary, there are several benefits of Greenhouse effect—: These are, but not limited to;

—Increase in extent and diversity of plant and vegetation life

—Good for plant growth

—Geological redistribution of population

Beyond this, there are a lot of political issues politicizing the economics of global warming [Schelling, 1992]. However, according to Schelling [1992], it is essential to keep global environmental issues enduringly on every government's agenda. On the issue of global warming— if that is really going on, and which is indeed going on [Vitousek, 1993], it must be addressed by the policy makers whose job is to oversee wellbeing of its subjects. The dispute is over the magnitude of impact that would translate into climatic changes which may influence human welfare and the natural habitat. In fact, Peter M. Vitousek, the MacArthur Award Winner Ecologist, deliberated three core issues pertaining to global warming in his paper encircling the issue of finding direct causal connections to global climate change. These are, a)

rising concentration of CO_2, b) alteration in the global nitrogen cycle and c) change in land cover use [Vitousek, 1994]. It shall be born in mind that the function of Earth is to support life and all living activities. The structure of the earth supports such functions related to biotic life. Any alterations in the structure would generally have certain impact on its functions— when earth is seen as a system. Ecologists have a deeper understanding about the earth as a system— the global environment, about biodiversity and on which they gather knowledge about the dynamics of such environmental alterations. However, since climatic change patterns are uncertain, ecologists should learn to deal with uncertainty related to such a system on regard to that— that the earth is a complex system. Decisions based on strategic framework should be implemented in response to any such observable changes in the environment and change in biodiversity only when those impact human welfare caused by global warming. There is a difference between something "causing" global warming and something "inducing" it. Anthropogenic factors that induce greenhouse gas emission may be said those of dismantling forest floor, and mining for fossil fuel, whereas, factors explicitly causing GHG emission relates to industrial activities and fossil fuel burning. Both these activities bring about ecological changes. It is the job of the ecologists to monitor and alert the policy makers about any such drastic changes in the environment or shifts in climatic patterns which nevertheless, should be assessed by the consortium of environmental scientists, researchers from other domains of science and beyond natural sciences. Policy makers, on the other hand, through workshops may well generate public awareness about the impact of greenhouse gases on human welfare, or they could place caps on industrial emissions levels, or formulate and endorse emission guidelines etc. Indeed, this problem, the problem of global warming is now a global issue—and hence, mandates a global effort toward mitigating this problem.

Globalization Globalizing Uncertainty

Undeniably, uncertainty has been one of the central concepts of organizational theory [Milliken, 1987], and more so in environmental sciences when we hear people

say about ecological uncertainties related to unknown or unpredictable variability in climatic and seasonal patterns, or environmental events. Understanding the forces of nature which shape climatic patterns can now be modelled adequately using computational simulations which apply satellite based geospatial imaging data, LANDSAT images, statistical models for forecasting weather patterns, rain, hurricanes and tropical cyclones, though nonetheless, all such predictions are *not always* precise. Inferences derived from Statistical hypothesis testing cannot be as well established on the notion of rejecting or accepting a null hypothesis—which is too limiting and often biased [Trenberth, 2005], but nevertheless, do provide some patterns or trends. This, coupled with the complex forces of globalization, our immediate environment, and our workspace—both have become more uncertain. Globalization is an anthropogenic process of socioeconomic evolution (development and progress), meaning increased mobility and universal access to resources; i.e., mass movements of goods, knowledge, and people and practice across borders, countries and continental regions. This mass mobility supported by freedom of movement and trade require massive resources which are natural; i.e., minerals, energy and fuel, as well, infrastructures—which are artificial edifices derived from natural resources. With this concord of globalization virtually touching every corner of the earth, more opportunities bolster a mass migration of rural populace who in search for a 'good life' and 'better job' opportunities, continue to relocate to urban areas which offer such productive prospects of prosperity and "fortune". The migrating population either actively or passively adapt to the new, complex and uncertain environment. In a sense, they couple with their environment but that which has too become unpredictable as well. In similar tune, extrapolation of weather patterns is a complex process of understanding the future uncertainties related to and the relationship of constructs in relation to their environment. In simple terms, uncertainty is a fundamental problem in organizations [Thompson, 1967] which are in anyway—complex systems.

Eventually, this shift in population distribution demands ever more space in urban metropolises and to meet such demand for urban expanses, the limits of urbanization are supplanting greeneries with reinforced edifices. This suburbanization nevertheless, have also placed a hefty constraint on energy resources like electricity and combustion fuels to support population migration across metropolis, wherein a majority of the share of resources are derived from non-renewable sources. Nevertheless, this drift in socioeconomic progress though unavoidable, but beyond doubt, much welcomed particularly in the developing nations who are riding on this bandwagon of economic boom and prosperity. With manifold growth in trade and industry since the inception of globalization, this shift appears to be coherent and spatial. However, since global sources of non-renewable resources are dwindling, there have been recent shift toward search for renewal energy resources which would have minimal impact on the ecology of the earth. In spite of these, there is no point to deny that depletion of forest resources and destruction of forest floor causes immense loss of biodiversity and species extinction.

Countering Global Warming

In the preceding sections, the discussion underlined the essence of the problem of biodiversity loss and emphasized several arguments to control greenhouse gas emission which leads to global warming. The dual aspects, which are—controlling environmental pollution, and search for alternative energy resources that would help conserve the ecosystem are categorized under two strategic recommendations. We shall consider these arguments independently in lieu of the subject matter revolving around controlling global warming and conserving biodiversity and reflect upon contemporary ideas which aim to cut down emission levels; i.e., by use of carbon credits, carbon trading, emissions trading, emission caps and other greenhouse gas reduction strategic recommendations. The strategy toward countering global warming is aimed from both angles- policy decisions to cut down emissions, and

from the technology point of view— toward adoption of sustainable green technology.

The Kyoto Protocol: Policy Options

Policy options based on several protocols adopted to cut down emissions levels have been signed by the policy head of states, most notable, Montreal Protocol, Kyoto Protocol, and others. In 1997, political leaders and policy makers from around the world gathered at Kyoto, Japan, for a World Treaty to formalize agendas in order to combat global warming caused by Greenhouse Gas (GHG) emissions, primarily, CO_2—thus, signing the "Kyoto Protocol"[UN,1998]. Due to complex ratification procedures, it became operational by February, 2005. The protocol, forming an agreement with joint declarations from 37 countries having binding obligations on industrialized nations to be responsible for their industrial activities in reducing greenhouse gases. The binding emission reduction commitments are meant to reduce the high levels of GHG emissions into the atmosphere emitted by the industrialized nations. This protocol, ever since then, has become a household tag for fight against global warming.

Alternative Energy: Technology Options

Towards Sustainable, Eco-friendly Green Environment

Our perception towards our environment has been changing of late; although the technological options though very limited, nevertheless, is proving to be useful. We are becoming more aware and conscious about the impact of biodiversity loss on the very same environment which supports our life. There have been lot of attention given towards "green life" and sustainable living [Ravago *et., al.* 2009]-—the green concept supplanting dwindling bio-reserves and forest floors. The concept of mass urbanization has not only caused immense problem in major developing metropolises of the world, but has led to higher sensitivity to pollution from vehicular emissions, industrial smog and irritant gases given out by coal fired industries, those running on fossil fuels. Higher levels of suspended particulates in

the atmosphere like sulphur dioxide, CO2, nitrogenous gases inducing respiratory diseases and posing as severe health hazards.

Technology can bridge the gap between what that is required to minimize the emission of pollutants in the atmosphere, and use of renewable energy sources those of which are clean energy technology. Recycling biomass, managing bio-wastes and using biodegradable materials to harness energy could cut down emission levels. Adoption of eco-conscious models of sustainability and preventing unnecessary burning of forage for clearing land for agriculture could also reduce CO_2 emission.

Conclusion

The paper draws the present scenario of the issue of global warming leading to the loss of biodiversity, ways to counter it, and policy actions as well as technological frontiers that could mitigate the problem in essence. The research further on discusses what initiatives should be taken, and how policy making and human actions could help mitigate the problem that we face today, regarding climatic shifts, whose effects might be more apparent as the time goes on. Time is precious, and hence, our common rationale mandates that actions should not be delayed if the perceived danger of the future is too big. By bridging policy making with tools of economic and technological gears, we could well prepare to face and model strategic initiatives to prevent what that is turning out to be a big, future, problem—the problem of global warming. And by doing so, we can as well, plan for a better, sustainable future economic growth scenario benefitting all and that which should stand on the motto of "industrialism without pollution".

Footnotes

[1]See the article Melting Down "The Heat is On", 2004. A special issue in National Geographic, by Tim Appenzeller & Dennis Dimick., pg. 2, Vol. 206, no. 3.

[2]"Thin Ice in the Arctic", 2004. National Geographic pg. 2, Vol. 206, no. 3.

[3]*ibid.*

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